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FRESH-WATER RHIZOPODS FROM THE WHITE MOUNTAIN REGION OF NEW HAMPSHIRE.

JOSEPH A. CUSHMAN AND WILLIAM P. HENDERSON.

SINCE the publication of the *Monograph of the Fresh-water Rhizopods of North America*, by Dr. Joseph Leidy, little work has been done upon this very interesting group, especially as regards New England. Their abundance and the singular beauty of some of the species should make them better known even to the most casual observer of the microscopic fauna of our ponds and streams. The number of species obtained from New Hampshire was not great yet when compared with the whole number of shelled forms reported from North America it is a very fair representation. Certain forms found are apparently new and are reserved for further study.

The region from which most of the specimens were obtained was not of great altitude nor of high latitude but nevertheless both of these conditions seem to play an important part in the comparative size of the individuals of the same species. In the summary at the end of the present paper is discussed the bearing of these points as made out from a study of the material under observation.

The material used in the preparation of the present paper was of two kinds: mounted and unmounted. The former is in the collection of the Boston Society of Natural History and represents the following localities: Saco Lake, Profile Lake, Lonesome Lake, Lake of the Clouds, Pinkham Notch, Franconia, Claremont, Gilmore Pond near Profile House, and Scribner's Brook, Wakefield. The unmounted material was preserved in formalin and represents the following localities: Pudding Pond at North Conway; Intervale; a pond at 5000 feet on Mt. Munroe; Mirror Lake in Chatham (all collected by Dr. Glover M. Allen); North Woodstock (including two lots from the Flume, collected by George A. Fisher); Squam Lake (collected by Herman

Gammons); and Mt. Moosilauke (collected by Warren A. Priest). Identified specimens from this latter group of localities are preserved in the collections of the writers and are referred to by slide numbers under each species. For the other localities the number of the slide in the collection of the Boston Society of Natural History which contains an identified specimen is given. Thus all the localities and species may be verified by actual material. A mounted set of material from the second set of localities has been deposited in the collection of the New England Microscopical Society.

The arrangement of the genera and species follows that of Leidy's monograph. The determinations also follow the same work as it is still the standard work of its kind for our species. The following species and varieties were identified:—

***Diffugia globulosa* Dujardin.**

The test of this species showed considerable variation. It was usually of coarse sand grains, but in some specimens included diatom valves, and in a few cases there was a chitinoid membrane with more or less extraneous matter attached to it. Several cases of dividing specimens were noted.

Size.—Length, 46–76 μ ; breadth, 40–87 μ ; diameter of aperture, 26–45 μ . As noted by Leidy, the specimens having the test composed of coarse sand grains are larger than those with a chitinous test.

Localities.—Mt. Munroe (Cushman Coll., nos. 193, 194); North Woodstock (Henderson Coll., no. 57, Cushman Coll., no. 181); Lake of the Clouds (B. S. N. H., no. 4319); Profile Lake (B. S. N. H., no. 4313); Franconia (B. S. N. H., no. 4307); Saco Lake (B. S. N. H., no. 4324).

***Diffugia pyriformis* Perty.**

Test of coarse angular sand grains, sometimes with included diatom valves. Frequently the outline of the shell was broken by irregularly projecting quartz grains of large size. In a collection from Squam Lake were found several very large speci-

mens, the tests presenting a dark brown appearance. Whether this color was a result of the dark hue of the sand, or arose from a lining membrane of brown chitin in which the grains were incorporated, was not surely made out. One test was unique: trailing from many points in its surface were long blackish streamers, one even longer than the test. Several cases of division were seen.

Size.—Length, 68–309 μ ; breadth, 35–201 μ ; aperture, 15–87 μ .

Localities.—North Woodstock (Cushman Coll., nos. 183, 187, Henderson Coll., nos. 51, 53, 63); small pond, 5000 ft. alt., Mt. Munroe (Cushman Coll., no. 196); Franconia (B. S. N. H., no. 4307); Pinkham Notch (B. S. N. H., no. 5164); Squam Lake (Cushman Coll., no. 198); Intervale (Cushman Coll., nos. 66, 67).

Of *D. pyriformis* the following varieties described by Leidy, (p. 99) were found: var. *compressa*, North Woodstock; var. *nodosa*, Intervale; var. *vas*, Intervale.

***Diffugia urceolata* Carter.**

Test of the typical form with the urceolate lip. As a rule, however, the lip was not as well marked as in the specimens figured by Leidy.

Size.—Length, 68 μ ; breadth, 58 μ ; aperture, 30 μ . This specimen is much smaller than that reported by Leidy.

Locality.—North Woodstock (Cushman Coll., no. 176).

***Diffugia acuminata* Ehrenberg.**

Test as a rule of coarse sand grains with the fundus of the test drawn out into more or less of an acuminate projection. This species seems to differ more or less in its comparative breadth as all gradations were noted from very slender to fairly broad specimens.

Size.—Length, 87–125 μ ; breadth, 46–60 μ ; aperture, 22–31 μ .

Localities.—North Woodstock (Cushman Coll., nos. 182, 189); Intervale (Cushman Coll., no. 152).

***Diffugia constricta* (Ehrenberg).**

Test usually of coarse sand grains; a yellow or brown chitinous membrane with irregularly scattered sand particles noted in one or two cases.

Size.—Length, 80–102 μ ; breadth, 59–75 μ ; aperture 22–37 μ .

Localities.—Lake of the Clouds (B. S. N. H., no. 4319); Claremont (B. S. N. H., no. 4662); Squam Lake (Cushman Coll., no. 199); North Woodstock (Henderson Coll., no. 62).

***Diffugia spiralis* Ehrenberg.**

Test of varying construction, in one or two cases built up of the vermiform chitinous pellets shown in Leidy's Plate 19, figure 7; in others, of fine, straight, spicule-like fragments. In one, many diatom valves were used. The neck showed much variation in length.

Size.—Length, 44–126 μ ; breadth, 38–96 μ ; aperture, 12–46 μ .

Localities.—North Woodstock (Cushman Coll., nos. 182, 183, 190); Squam Lake (Cushman Coll., no. 197); Gilmore Pond near Profile House (B. S. N. H., no. 4314).

***Hyalosphenia cuneata* Stein.**

Test of delicate chitinous membrane, colorless and unornamented.

Size.—Length, 60 μ ; breadth, 42 μ ; aperture, 24 μ .

Locality.—North Woodstock (Henderson Coll., no. 53).

***Hyalosphenia papilio* Leidy.**

Test a delicate and beautiful case of light straw-colored chitin.

Size.—Length, 111–118 μ ; breadth, 67–69 μ ; aperture, 31–32 μ .

Localities.—Mt. Munroe (Henderson Coll., no. 102); Mirror Lake, Chatham (Cushman Coll., no. 157).

***Hyalosphenia elegans* Leidy.**

Test of yellowish brown chitin with the characteristic regular longitudinal corrugations. In the specimen examined a peculiar large irregular projection showed near the apex.

Size.—Length, 90 μ ; breadth, 58 μ ; aperture, 15 μ .

Locality.—Mt. Munroe (Henderson Coll., no. 101).

***Quadrula symmetrica* (Wallich).**

Test as name suggests, composed of a tiling of delicate, unmarked, square, chitinous plates. These plates increase in size toward the fundus.

Size.—Of specimens viewed on broader side, length, 58–78 μ ; breadth, 28–46 μ ; oval end, 14–21 μ . One rather larger, but turned so that a slightly oblique view of the narrower side was afforded, gave measurements: length, 87 μ ; breadth, 33 μ ; aperture, 7 μ . In this specimen the rounding notch of the aperture is visible.

Localities.—North Woodstock (Cushman Coll., no. 181, Henderson Coll., no. 63); Saco Lake (B. S. N. H., nos. 4235, 4325); Franconia (B. S. N. H., no. 4307); Pinkham Notch (B. S. N. H., no. 5148).

***Nebela collaris* (Ehrenberg).**

Test in most of the specimens examined is composed of circular or ovoid plates, transparent and colorless. Several specimens showed straight or curved longitudinal plates mingled with the circular ones. One was bent strongly on one side giving a curved form to the shell.

Size.—Length, 65–196 μ ; breadth, 44–108 μ ; aperture, 14–46 μ .

Localities.—North Woodstock (Cushman Coll., nos. 176, 178, 180, Henderson Coll., nos. 52, 65); Lake of the Clouds (B. S. N. H., no. 4319); Profile Lake (B. S. N. H., no. 4313); Pinkham Notch (B. S. N. H., no. 5164); Saco Lake (B. S. N. H., nos. 4233, 4323); Mirror Lake, Chatham (Cushman Coll., nos. 156, 157).

Nebela flabellulum Leidy.

Test largely composed of circular disks much as in the preceding.

Size.—Length, 63–90 μ ; breadth, 75–100 μ ; aperture, 18–20 μ .

Localities.—Lake of the Clouds (B. S. N. H., no. 4319); Scribner's Brook, Wakefield (B. S. N. H., no. 4786); Mt. Moosilauke (Henderson Coll., no. 74).

Arcella vulgaris Ehrenberg.

Test a yellowish or brown chitinous membrane, with minutely hexagonal cancellation. The common form of the upper surface is an evenly rounded dome, but two or three individuals showed top and sides depressed into bluntly angular facets.

Size.—Length, 42 μ ; breadth, 23–54 μ ; aperture, 11–15 μ .

Localities.—Mt. Munroe (Cushman Coll., no. 194); Saco Lake (B. S. N. H., nos. 4235, 4323).

Arcella discoides Ehrenberg.

Test of same material as in the preceding, in form more flattened.

Size.—Length, 29–44 μ ; breadth, 77–108 μ ; aperture, 19–42 μ .

Locality.—North Woodstock (Cushman Coll., nos. 176, 179, 198, Henderson Coll., nos. 54, 64).

Arcella mitrata Leidy.

Test of same material as in the preceding. In form, viewed either from above or from below, with the circular outline broken by the salient angles of the strongly marked facets. In side view, the shell is crown-shaped.

Size.—Length, 63–135 μ ; breadth, 67–155 μ ; aperture, 34–63 μ .

Localities.—Lake of the Clouds (B. S. N. H., no. 4319); Pudding Pond, North Conway (Henderson Coll., no. 70).

Centropyxis aculeata (Ehrenberg).

Test of yellow or brown chitin as in Arcella. In some of the specimens examined, quartz grains were incorporated in the membrane. The form is always characteristic: mouth and fundus eccentric in opposite directions. The typical form has several spines crowning the fundus.

Size.—Greater diameter, 89–153 μ ; shorter diameter, 66–93 μ ; aperture, 19–57 μ .

Localities.—North Woodstock (Henderson Coll., nos. 52, 60, 61); Squam Lake (Cushman Coll., no. 197); Pudding Pond, North Conway (Henderson Coll., no. 70); Intervale (Henderson Coll., nos. 66, 69); Gilmore Pond near Profile House (B. S. N. H., no. 4314); Claremont (B. S. N. H., no. 4662).

Centropyxis aculeata var. **ecornis** (Ehrenberg).

As the name implies, the fundus is not crowned with spines. One specimen examined showed the Arcella-like cancellation of the shell noted by Leidy (p. 183).

Size.—Average length, 48 μ ; longer diameter, 48–144 μ ; aperture, 12–41 μ .

Localities.—North Woodstock (Cushman Coll., no. 176, Henderson Coll., nos. 53, 62); Mt. Munroe (Cushman Coll., nos. 194, 196); Profile Lake (B. S. N. H., no. 4313); Franconia (B. S. N. H., no. 4307); Saco Lake (B. S. N. H., nos. 4325, 4324).

Cyphoderia ampulla (Ehrenberg).

The test in all specimens examined was of similar structure, and varied comparatively little in size. It is a delicate chitinous membrane, colorless or faintly yellow, showing minute hexagonal cancellation; rim of oval aperture finely beaded.

Size.—Length, 104–143 μ ; extreme breadth, 42–50 μ ; aperture, 14–18 μ .

Localities.—North Woodstock (Cushman Coll., no. 189, Henderson Coll., nos. 51, 52, 63); Squam Lake (Cushman Coll., no. 198); Lake of the Clouds (B. S. N. H., no. 3719); Profile

Lake (B. S. N. H., no. 4313); Pudding Pond, North Conway (Henderson Coll., no. 71); Claremont (B. S. N. H., no. 4662).

Euglypha alveolata Dujardin.

Test chitinous, transparent and colorless. In form, generally a regular ovoid shape, truncated at the smaller end. One or two specimens were narrower and more flask-shaped. About half of the shells examined had spines.

Size.—Length, 48–91 μ ; breadth, 31–46 μ ; aperture, 12–18 μ .

Localities.—Profile Lake, Claremont, Franconia, and Saco Lake (B. S. N. H., nos. 4313, 4662, 4307, 4325).

Euglypha ciliata (Ehrenberg).

The plates in the tests of the specimens did not seem to overlap. In one specimen the cilia were few and long, in the others more numerous and shorter.

Size.—Length, 70–78 μ ; breadth, 37–42 μ ; aperture, 16–18 μ . These were all found in the valley and show little variety in size.

Localities.—North Woodstock (Cushman Coll., nos. 176, 181, Henderson Coll., no. 65); Intervale (Henderson Coll., no. 67); Profile Lake (B. S. N. H., no. 4213).

Trinema enchelys (Ehrenberg).

Closely corresponds to figure 1 of Plate 39 of Leidy.

Size.—Length, 81 μ ; breadth, 44 μ ; aperture, 16 μ .

Locality.—Franconia (B. S. N. H., no. 4307).

Acanthocystis chætophora Schrank.

But one specimen of this species was found and that was typical in every way.

Size.—Breadth with spines, 125 μ ; breadth of body, 54 μ ; length of spine, 24 μ .

Locality.—North Woodstock (Cushman Coll., no. 190).

Besides the recording of the species from this general region, one further use was made of this material: a comparison was made with the average measurements of Leidy. The results of this comparison may best be seen in the following table:—

	Aper- ture.				Aper- ture.			Leidy-Average.		
	Lgth.	Bdth.			Lgth.	Bdth.		Lgth.	Bdth.	
<i>Diffugia constricta.</i>										
Intervale	178	117	49	Mt. Munroe	68	37	15	320	140	68
<i>Nebela collaris.</i>										
Squam Lake	102	75	37	Lake of the Clouds	80	59	22	161	135	—
<i>Arcella mitrata.</i>										
North Conway	—	155	63	Lake of the Clouds	—	67	34	—	142	50
<i>Centropyxis ecornis.</i>										
North Woodstock	—	83	34	Mt. Munroe	—	59	28	—	146	64

From the above table, which represents the conditions seen in almost all the species under observation, the difference in size between the average measurements of Leidy for the whole of North America and the average measurements for this region is at once apparent. That this is due rather to latitude than altitude it seems safe to infer as the valley lakes are no higher than many of the medium records of Leidy. If it is safe to draw a conclusion from this, it at least seems to indicate that these animals are as a rule smaller in higher latitudes than in lower. Such a conclusion, of course, cannot be of great weight unless worked out in other cases, but is at least indicated here.

The other point which seems much more certain by direct comparisons in this same general locality is that some species are smaller on the tops of the mountains than they are in the valleys of the same region. In the first column are given the measurements of typical valley specimens and in the second column the measurements of specimens of the same species from lakes of about 5000 feet altitude. The differences in this case are at once marked and definite and it may be said with every degree of certainty for the species here worked out that a species at high altitudes will be smaller than the same species in lower altitudes of the same region. This one fact seems to repay the time spent in working up the various lots of material.